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Preliminary Results of VLBI observations of the Chang'E-3 Lunar Lander

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The successful deployment of the Chang'E-3 Lander on the Moon on Dec 14th, 2013 has opened a new window for VLBI observations of the Moon. Following proposals to the IVS Observing Program Committee, a global IVS R&D network augmented with two China Deep Space Stations was configured for joint observations of the lander in a project called OCEL (Observing the Chang'E-3 Lander with VLBI). From July 2014 to December 2015, the Chang'E-3 Lander was observed successfully during several 24-hour sessions. More than 10 stations distributed all around the world participated in each observing session. In this paper, correlation results of the Beijing Aerospace Control Center (BACC) for sessions in 2014 are presented, concentrating on the software correlator, key algorithms and observable accuracy analysis.

BSCS(BACC Software Correlator System) is designed to run on Beowulf clusters consisting of commodity machines with parallel processing algorithms adopted in the software.

For the OCEL observations, the DeltaDOR mode was adopted, which means a sequence of "Quasar - ChangE'3 - Quasar". Here, quasars with small separation angles are preferred to eliminate common errors as much as possible. The ChangE'3 Lander is equipped with an X-band transponder which transfers an X-band carrier and four DOR tones at ± 19.25 MHz and ± 3.85 MHz in coherent modes. With a spanned bandwidth of 38.5 MHz, DOR tones are recorded in five different channels. Phase calibration (PCAL) is used to remove any offset in phase due to the BBCs electronics of different channels. When the phases of the PCAL tones are too noisy, a strong calibrator is used to manually specify the phase of each channel. The group delay is computed by bandwidth synthesis. The preliminary accuracy analysis shows that the delay observables of Chang'E-3 are better than 1 ns, depending on the signal-to-noise ratio of the different baselines.

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